VIRGINIA RECREATIONAL FISHING DEVELOPMENT FUND
SUMMARY PROJECT APPLICATION*

NAME AND ADDRESS OF APPLICANT:

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PROJECT LEADER (name, phone, e-mail):

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PRIORITY AREA OF CONCERN:

Habitat Improvement

PROJECT LOCATION:

VMRC Artificial Reef sites--Northern Neck reef and Poquoson reef

DESCRIPTIVE TITLE OF PROJECT:

Performance of Artificial Fish Reef Types: Concrete Modules, Reef Balls and Materials-of-Opportunity Reefs

PROJECT SUMMARY:

This proposal requests funds to complete the currently funded RFAB project to determine the optimal design of subtidal artificial fish reefs. The proposal is part of a larger project aimed at determining an optimal reef design to enhance recreational fish and fish prey production. The other critical element of the project concerns habitat suitability and the prey base for recreational fish on these artificial reefs, which is presented in a complementary proposal by Seitz. Ultimately, we seek to determine which of various artificial reef types, including ReefBalls and concrete modules, provides the optimal reef design to increase recreational fish production in a network of artificial reefs throughout the waters of the Virginia portion of Chesapeake Bay.

EXPECTED BENEFITS:

Successful completion of this project will result in identification of an optimal reef design that enhances recreational fish production of Virginia's artificial reefs. For example, if Concrete Module reefs are more productive, it may be cheaper to build new concrete modules than to purchase and deploy Reef Balls, or deploy Materials of Opportunity. Our group is working together with VMRC and CCA to determine the most effective means of implementing a network of artificial reefs that will serve as stable habitats providing food and shelter for recreational fish species. The recreational fishing community is expected to profit from the enhancement of fish production.

COSTS:

VMRC Funding:	$68,024
Recipient Funding:	$8,931
Other Funding Sources (please list) :	State/NOAA/ACoE
Total Costs:	$76,955

Detailed budget must be included with proposal.

Updated 4/27/06

***This form alone does not constitute a complete application, contact Sonya Davis at 757-247-8155 or sonya.davis@mrc.virginia.gov**

Performance of Artificial Fish Reef Types: Concrete Modules, Reef Balls and Materials-of-Opportunity Reefs

P.I.: R.N. Lipcius

Co-P.I.: R.D. Seitz

1.) **Need**

1a.) **Introduction**

A comprehensive review and recent field investigations have demonstrated that the production of various recreationally valuable fish can be increased by different types of artificial reefs (Peterson et al. 2003). Enhancement occurs either through the provision of habitat and food for structure-dependent fish such as sheepshead and tautog (recruitment enhancement), or by increasing the availability of reef prey (growth enhancement) for transient fish such as black sea bass that use the reefs as a foraging ground. For example, the biomass of sheepshead was increased annually by 0.6 kg per 10 m^2 and that of black sea bass by 0.4 kg per 10 m^2 (Peterson et al. 2003). Artificial reefs can also enhance commercially valuable fish, as in the case in New Zealand where blue cod fishery landings increased by over 500 % in areas where oyster reefs were protected to provide habitat for blue cod (Cranfield et al. 2001). In general, the production of recreationally and commercially important fish has been augmented considerably by a diverse set of artificial fish reefs, including oyster reefs, even when such reefs also concentrate fish (Seaman 2000).

The effectiveness of alternative reef structures as excellent fish and invertebrate communities was evident in our examination of artificial reefs in the James River, in the lower Rappahannock River, and in Lynnhaven River. The habitat and food provided by the reef communities supported a diverse assemblage of mud crabs, polychaete worms, small mollusks, reef fish, and other species that serve as potential prey for larger, recreationally valuable fish.

Our recent investigations have indicated that particular types of alternative reefs (Figure 1) can increase abundance of recreationally valuable fish such as sheepshead, black sea bass, and tautog. Specifically, various recreational fishers have caught these species near the alternative reefs, and we have directly observed these fish on or near the alternative reefs (personal observations by R.N. Lipcius and by D. Bushey of Commonwealth Pro-Dive). Numerous video and diver observations indicated that sheepshead, black sea bass, tautog, striped bass (rockfish) and other fish used the reefs as shelter or as foraging grounds. These observations are consistent with the general conclusions by Peterson et al. (2003) on the utility of artificial reefs in enhancing the production of recreational fish species.

With RFAB funding, we began a cooperative effort with M. Meier and J. Grist of VMRC to evaluate the effectiveness of different types of artificial reefs in enhancing the

abundance and production of recreational fish and their prey on the reefs. Besides VMRC and VIMS, the effort also involves the Army Corps of Engineers—Norfolk District, Chesapeake Bay Foundation, Rappahannock Preservation Society, Lynnhaven Now, City of Virginia Beach and private citizens. We have also been interacting with the Coastal Conservation Association (CCA) and Charter Boat Captain's Association of the Northern Neck due to their interest in augmenting the production of recreational fish for Virginia anglers. The overall goal of this effort is to determine the optimal structure and placement of artificial reefs that will maximize the production of fish. Some work has been conducted in the Rappahannock River, Lynnhaven River, and James River (Lipcius and Burke 2006, Burke and Lipcius manuscript in preparation, Seitz et al. manuscript in preparation, Lipcius et al. VIMS report in preparation).

This proposal requests funds to complete the currently funded RFAB project to determine the optimal design of subtidal artificial fish reefs. The proposal is part of a larger project aimed at determining an optimal reef design to enhance recreational fish and fish prey production. The other critical element of the project concerns habitat suitability and the prey base for recreational fish on these artificial reefs, which is presented in a complementary proposal by Seitz. Ultimately, we seek to determine which of various artificial reef types provides the most suitable shelter and feeding area for recreationally important fish and their prey. We will incorporate our findings with those of the complementary project by Seitz on the prey base for recreational fish species, and subsequently provide recommendations on the optimal reef design to increase recreational fish production in a network of artificial reefs throughout the waters of the Virginia portion of Chesapeake Bay. This project therefore falls under the category of Habitat Improvement.

1b.) **Accomplishments**

Under the current RFAB grant we have accomplished the following:

- **Deployment of 8 artificial reef systems (Figure 1) at the Northern Neck and Poquoson reef sites of VMRC.**
- **Assessment of habitat quality at the Northern Neck and Poquoson reef sites.**
- **Collaboration with M. Meier and J. Grist of VMRC on habitat assessment and optimal reef structure of Virginia's artificial reefs.**
- **Identification of a cheaper artificial reef (Figure 1) that serves as nursery and adult habitat for structure-dependent fish (e.g. black sea bass).**
- **Initial surveys of the artificial reefs.**
- **Attended meetings of Northern Neck Charter Boat Captains Association.**

2a.) **Objectives**

A) Evaluate recreational fish production on alternative artificial reefs at Northern Neck reef and Poquoson reef, and compare these with existing materials-of-opportunity reefs and Reef Balls.

B) In conjunction with the habitat quality, prey base and food web information from the complementary project by Seitz, determine the optimal reef type for maximizing recreational fish production and prey abundance.

2b.) **Remaining activities**

- **Assessment and comparisons of the artificial reefs, reef balls and materials of opportunity.**
- **Why? To provide an economical and effective reef system for Virginia's artificial reef program, and to minimize the potential for overfishing through concentration of fish rather than increased production.**
- **Assessment of habitat quality at the Northern Neck and Poquoson reef sites.**
- **Why? To determine reef areas where artificial reefs are most productive and eliminate waste resulting from placement of reefs in areas that are impacted by poor environmental conditions.**

3.) **Expected Results or Benefits**

Successful completion of this project will result in identification of an optimal reef design that enhances recreational fish production of Virginia's artificial reefs. For example, if Concrete Module reefs are more productive, it may be cheaper to build new concrete modules than to purchase and deploy Reef Balls, or deploy Materials of Opportunity. Our group is working together with VMRC and CCA to determine the most effective means of implementing a network of artificial reefs that will serve as stable habitats providing food and shelter for recreational fish species. The recreational fishing community is expected to profit from the enhancement of fish production. We have also communicated with J. Travelstead and M. Meier of VMRC's Fisheries Division to make sure that the artificial reefs are consistent with VMRC's philosophy on creation of artificial fish reefs.

4.) **Approach**

Reef structures will be surveyed June-November 2008 to allow for colonization by fish in the previous spring and summer. Abundance of fish (this project) and invertebrate prey (Seitz project) will be quantified in August and November 2008. Fish production will be quantified with a combination of an underwater video system, direct diver observations, and selective capture of fish with traps. The underwater video system will not be purchased with RFAB funds. Most of the observations will be conducted with the video system, and verified with periodic diver observations and trap sampling. These observations will give us direct measures of fish recruitment and foraging at each of the reef types.

Production will be calculated by using published length-weight relationships. The total production of the reef system will be ascribed to the reef types by partitioning the production according to the video and diver observations. The video system is a proven

means of sampling fish under low visibility, as is diver observation. The abundance of fish on the various reef types will be analyzed statistically to determine which reef type is optimal in enhancing fish production.

This project will be a collaboration among several entities and personnel, and leverage various sources of funding to decrease the cost to VMRC and the state:

VIMS—R. Lipcius will coordinate the project and interact with R. Seitz on the complementary food web/prey availability project, and with H. Wang, J. Shen and M. Sisson on the existing hydrodynamic models for the lower Chesapeake Bay. A substantial portion of personnel costs is covered by other sources.

CCA—We are working with representatives of CCA and Charter Boat Captains to advise on sites for the artificial reefs.

VMRC—Lipcius is working directly with M. Meier in the Fisheries Division to ensure that the proposed reef systems are in agreement with the goals and needs of the artificial reef program at VMRC.

NOAA—The Chesapeake Bay Office has funded some of the pilot studies conducted with the Rappahannock River artificial reefs.

5.) **Location**:

The study sites are VMRC's reef sites, specifically the Northern Neck reef and Poquoson reef.

References

Cranfield HJ, Carbines G, Michael KP, Dunn A, Stotter DR, Smith DJ (2001) Promising signs of regeneration of blue cod and oyster habitat changed by dredging in Foveaux Strait, southern New Zealand. NZ J Mar Freshwater Res 35:897-908

Downing JA, Rigler FH (Eds). 1984. A manual on methods for the assessment of secondary productivity in fresh waters. Blackwell Publishers.

Lipcius RN, Burke R (2006) Abundance, biomass and size structure of eastern oyster and hooked mussel on a modular artificial reef in the Rappahannock River, Chesapeake Bay. VIMS Special Report in Applied Marine Science and Ocean Engineering No. 390

Peterson CH, Grabowski JH, Powers SP (2003) Estimated enhancement of fish production resulting from restoring oyster reef habitat: quantitative valuation. Mar Ecol Prog Ser 264:249–264

Seaman WS Jr (2000) Artificial reef evaluation with application to natural marine habitats. CRC Press, Boca Raton, FL.

Figure 1. Constructed artificial fish reef. Eight have been deployed at two VMRC reef sites, Northern Neck and Poquoson.

6.) **Estimated Cost and Justification**

	VMRC	VIMS
Salaries		
Lipcius, PI - 1 month	9,542	
Marine Scientist (BS level) - 6 months	17,850	
Fringe, 35% salaries; 7.65% waged	9,587	
Supplies		
SCUBA supplies and accessories ($4,800); miscellaneous field supplies ($4,500); Software ($1400)	10,700	
Travel		
Meetings and Field sites - ~275 miles RT @$.58/mile VIMS truck; tolls; Lodging; Per diem	2,400	
Vessel Rental		
Rental - $120/day x 12 days	1,440	
Equipment		
Dissolved Oxygen Meter	2,900	
Facilities & Administrative Costs (25%)	13,605	8,931
Total	68,024	8,931

Personnel salaries are for the coordination and conduct of the work. As leveraging, the salaries of two other staff and two additional graduate students will be covered under other grants. We have applied the allowable 35% fringe for faculty and 7.65% for hourly staff. We request 12 days of boat time on a VIMS vessel (large privateer) for sampling the reefs plus fuel (listed in supplies). Supply costs include sampling materials, some SCUBA gear that will be used in this project and in future projects, software, and miscellaneous supplies. Supplies also include vessel fuel at $50 fuel per day for 12 days. Travel includes trucks for trailering boats from the VIMS main campus to field sites at $0.58 per mile for 12 days. In addition, we request $2,900 to replace a Dissolved Oxygen/Water Quality Meter that will be used to replace a malfunctioning meter that has been discarded. Indirect costs are charged at the rate of 25% with 20% match, with the exception of service centers and equipment.